U.S. Army School of Aviation Medicine

# Flight Medic Pharmacology

# *Objectives*

- Names of Drugs
- Sources of drugs
- Drug Classification
- Sources of drug information
- “Classic” Pharmacologic Format
- Schedule of controlled substances
- Special considerations in drug therapy
- The scope of management
- Autonomic pharmacology
- General properties of drugs
- Drug forms
- Routes of medication administration
- Commonly used ACLS Drugs

# *Names of Drugs*

- Drugs - chemical agents used in the diagnosis, treatment, or prevention of disease
- Pharmacology - the study of drugs and their actions on the body
- Chemical name - a precise description of the drug's chemical composition and molecular structure
- Generic name or non-proprietary name;

I. Official name approved by the FDA and usually suggested by the first manufacturer

- Trade or proprietary name - the brand name registered to a specific manufacturer or owner
- Official name - the name assigned by USP

# *Sources of drugs*

- Plants
  I. Alkaloids
  II. Glycosides
  III. Gums
  IV. Oils
- Animals and humans
- Minerals or mineral products
- Chemical substances made in the laboratory

# *Drug Classification*

- Drugs are classified

I. By body system (CV, GI, Neuro, etc)

II. Class of agent (Anti-xxx, Electrolyte, Benzo, etc)

III. Mechanism of action
  - Binds with alpha and beta receptors
  - Competes with acetylcholine
  - Relaxes smooth muscle
  - Prevents formation of thromboxane A2

# *Sources of drug information*

- AMA Drug Evaluation
- Physician's Desk Reference (PDR)
- Hospital Formulary (HF)
- Drug inserts
- Other texts, sources (i.e. field guides, pocket guides)

# *"Classic" Pharmacologic Format*

- Classification. What system does it affect?
- Mechanism of action. What it does?
- Indications. What it is used for?
- Contraindications. What it is not used for?
- Dose. How much to give or take?
- Route. Where to give it?
- Adverse Effects. What to watch out for?

# *Schedule of controlled substances*

- Controlled Substances Act, 1970 (Comprehensive Drug Abuse Prevention and Control Act,1970)
- Purpose for scheduling controlled substances, based upon abuse potential
- Classification of drugs into numbered levels or schedules (I to V)

# *Schedule Continued*

- Schedule I
  - a. High abuse potential
  - b. No currently accepted medical use
    - (1) For research, analysis, or instruction only
    - (2) May lead to severe dependence
  - c. Examples
    - (1) Heroin
    - (2) LSD
    - (3) Mescaline

# *Schedule Continued*

- Schedule II
  - a. High abuse potential
  - b. Accepted medical uses; may lead to severe physical and/ or psychological dependence
  - c. Examples:
    - (1) Opium
    - (2) Morphine
    - (3) Codeine
    - (4) Oxycodone
    - (5) Methadone
    - (6) Cocaine
    - (7) Secobarbital

# *Schedule Continued*

- Schedule III
  - a. Less abuse potential than drugs in Schedules I and II
  - b. Accepted medical uses - may lead to moderate/ low physical dependence or high psychologic dependence
  - c. Examples:

(1) Preparations containing limited opioid quantities, or combined with one or more active ingredients that are noncontrolled substances

(a) Acetaminophen with codeine

(b) Aspirin with codeine

# *Schedule Continued*

- Schedule IV

a. Lower abuse potential compared to Schedule III

b. Accepted medical uses - may lead to limited physical or psychological dependence

c. Examples

(1) Phenobarbital

(2) Diazepam

(3) Lorazepam

# *Schedule Continued*

- Schedule V

a. Low abuse potential compared to schedule IV

b. Accepted medical uses - may lead to limited physical or psychological dependence

c. Examples:

(1) Medications, generally for relief of coughs or diarrhea, containing limited quantities of certain opioid controlled substances

# *Special considerations in drug therapy*

- Pregnant patients

1. Before using any drug during pregnancy, the expected benefits should be considered against the possible risks to the fetus
2. The FDA has established a scale (Categories A, B, C, D, and X) to indicate drugs that may have documented problems in animals and/ or humans during pregnancy
3. Many drugs are unknown to cause problems in animals and/ or humans during pregnancy
4. Pregnancy causes a number of anatomical and physiological changes
5. Drugs may cross the placenta or through lactation

# *Pediatric / Geriatric Patients*

- Pediatric:

1. Based on the child's weight or body surface area
2. Special concerns for neonates
3. Length-based resuscitation tape should be used

- Geriatric:

1. The physiological effects of aging can lead to altered pharmacodynamics and pharmacokinetics (use less due to aging body systems)

# *The scope of management*

- Flight medics are held responsible for safe and therapeutically effective drug administration
- Are personally responsible - legally, morally, and ethically - for each drug they administer
- Flight medics must:

1. Use correct precautions and techniques
2. Observe and document the effects of drugs
3. Keep their knowledge base current to changes and trends in pharmacology
4. Establish and maintain professional relationships
5. Understand pharmacology
6. Perform evaluation to identify drug indications and contraindications
7. Seek drug reference literature

# *The scope of management continued*

8. Take a drug history from their patients including:

a. Prescribed medications

(1) Name

(2) Strength

(3) Daily dosage

b. Over-the-counter medications

c. Vitamins

d. Drug reactions

9. Consult with medical direction

# *Autonomic pharmacology*

- Nervous system organization and function

1. Characteristics of nervous system components:

a. Central nervous system

b. Somatic system

c. Autonomic nervous system (ANS)

d. Sympathetic branch of ANS

e. Parasympathetic branch of ANS

# *Autonomic nervous system*

- Autonomic nervous system characteristics:

1. Parasympathetic (feed and breed)

a) S-salivation
b) L-lacrimation
c) U-urination
d) D-defecation
e) G-gastric mobility
f) E-emesis

- Parasympathetic chemical transmitter: acetylcholine

# *Autonomic nervous system continued*

- Sympathetic (fight or flight)

a) Pupils dilate
b) Muscles engorge with blood
c) Heart rate increases
d) Respiratory rate increases
e) SLUDGE shuts down

- Sympathetic chemical transmitter: Norepinephrine and Epinephrine

# *General properties of drugs*

- Drugs do not confer any new functions on a tissue or organ in the body, they only modify existing functions
- Drugs in general exert multiple actions rather than a single effect
- Drug action results from a physiochemical interaction between the drug and a functionally important molecule in the body
- Drugs that interact with a receptor to stimulate a response are known as agonists
- Drugs that attach to a receptor but do not stimulate a response are called antagonists

# *General properties of drugs continued*

- Drugs that interact with a receptor to stimulate a response, but inhibit other responses are called partial agonists
- Once administered, drugs go through four stages

1. Absorption
2. Distribution
3. Metabolism
4. Excretion

# *Drug forms*

- Liquid drugs

1. Solutions
2. Tinctures
3. Suspensions
4. Spirits
5. Emulsions
6. Elixirs
7. Syrups

# *Drug forms continued*

- Solid drug forms

1. Pills
2. Powders
3. Tablets
4. Suppositories
5. Capsules

- Gas forms

# *Routes of medication administration*

- Inhalation route (nebulized medications)

- Enteral (drugs administered along any portion of the gastrointestinal tract)

a. Sublingual

b. Buccal

c. Oral

d. Rectal

e. Nasogastric

# *Routes of medication administration*

- Parenteral (any medication route other than the gastrointestinal tract)

a. Subcutaneous

b. Intramuscular

c. Intravenous

d. Pulmonary (ETT)

e. Intradermal

f. Transdermal

g. Umbilical

h. Intraosseous

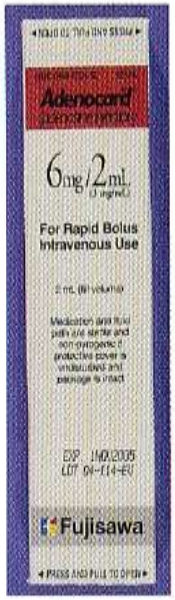
i. Nasal

# *Commonly Used ACLS Drugs*

# *Adenosine (Adenocard)*

## ADENOSINE (ADENOCARD) 3

**Classification:**
Antidysrhythmic




### INDICATIONS:

- Stable reentry SVT
- Does not convert AF, atrial flutter, or VT

### ADVERSE REACTIONS:

- Common adverse reactions are generally mild and short-lived.
- Sense of impending doom
- Complaints of flushing
- Chest pressure
- Throat tightness
- Numbness
- May be a brief episode of asystole after administration

### MECHANISM OF ACTION:

Slows the conduction of electrical impulses at the AV node.

# *Adenosine (Adenocard)*

## ADENOSINE (ADENOCARD)

**CONTRAINDICATIONS:**

- Sick sinus syndrome
- Second- or third-degree heart block
- Poison- or drug-induced tachycardia

**DOSAGE:**

**Note:** Adenosine should be delivered only by rapid IV bolus with a peripheral IV or directly into a vein, in a location as close to the heart as possible, preferably in the antecubital fossa. Administration of adenosine should be immediately followed by a saline flush, and then the extremity should be elevated.

Adult:

- 6 mg rapid IV, IO (over a 1- to 3-second period) immediately followed by a 20-mL rapid saline flush
- If the first dose does not eliminate the rhythm in 1 to 2 minutes, 12 mg rapid IV, IO; repeat a second time if required

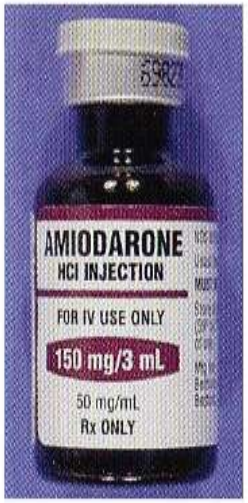
Pediatric:

- **For children >50 kg:** same as adult dosing.
- **For children <50 kg:** 0.1 mg/kg IV, IO (max dose: 6 mg) immediately followed by a ≥5-mL rapid saline flush; may repeat at 0.2 mg/kg (max dose: 12 mg)

# *Amiodarone (Cordarone)*

## AMIODARONE (CORDARONE) 8

**Classification:**
Antidysrhythmic




**INDICATIONS:**
- Ventricular arrhythmias
- Second-line agent for atrial arrhythmias

**ADVERSE REACTIONS:**
- Burning at the IV site
- Hypotension
- Bradycardia

**CONTRAINDICATIONS:**
- Sick sinus syndrome
- Second- and third-degree heart block
- Cardiogenic shock
- When episodes of bradycardia have caused syncope
- Sensitivity to benzyl alcohol and iodine

**MECHANISM OF ACTION:**
Acts directly on the myocardium to delay repolarization and increase the duration of the action potential.

# *Amiodarone (Cordarone)*

## AMIODARONE (CORDARONE)

**DOSAGE:**

Ventricular Fibrillation and Pulseless Ventricular Tachycardia:

**Adult:** 300 mg IV/IO; may be followed by one dose of 150 mg in 3 to 5 minutes

**Pediatric:** 5 mg/kg (max dose: 300 mg); may repeat 5 mg/kg IV, IO up to 15 mg/kg

Relatively Stable Patients with Arrhythmias such as Premature Ventricular Contractions or Wide Complex Tachycardias with a Strong Pulse:

**Adult:** 150 mg in 100 mL $D_5W$ IV, IO over a 10-minute period; may repeat in 10 minutes up to a maximum dose of 2.2 g over 24 hours

**Pediatric:** 5 mg/kg very slow IV, IO (over 20 to 60 minutes); may repeat in 5-mg/kg doses up to 15 mg/kg (max dose: 300 mg)

# *Lidocaine (Xylocaine)*

## LIDOCAINE (XYLOCAINE) 53

**Classification:**

Antidysrhythmic


### MECHANISM OF ACTION:

Blocks sodium channels, increasing the recovery period after repolarization; suppresses automaticity in the His-Purkinje system and depolarization in the ventricles.

### INDICATIONS:

- Ventricular arrhythmias, when amiodarone is not available
- Cardiac arrest from VF/VT
- Stable monomorphic VT with preserved ventricular function
- Stable polymorphic VT with normal baseline QT interval and preserved left ventricular function (when ischemia and electrolyte imbalance are treated)
- Stable polymorphic VT with baseline QT-prolongation suggestive of torsades de pointes

### ADVERSE REACTIONS:

- Toxicity (signs may include anxiety, apprehension, euphoria, nervousness, disorientation, dizziness, blurred vision, facial paresthesias, tremors, hearing disturbances, slurred speech, seizures, sinus bradycardia)
- Seizures without warning
- Cardiac arrhythmias
- Hypotension
- Cardiac arrest
- Pain at injection site

# *Lidocaine (Xylocaine)*

## LIDOCAINE (XYLOCAINE)

**CONTRAINDICATIONS:**

- AV block
- Bleeding
- Thrombocytopenia
- Known sensitivity to lidocaine, sulfite, or paraben
- Use with caution in bradycardia, hypovolemia, cardiogenic shock, Adams-Stokes syndrome, Wolff-Parkinson-White syndrome

**DOSAGE:**

**Pulseless Ventricular Tachycardia and Ventricular Fibrillation:**

**Adult IV, IO:**

- 1 to 1.5. mg/kg IV, IO; may repeat at half the original dose (0.5-0.75 mg/kg) every 5 to 10 minutes to a maximum dose of 3 mg/kg
- If a maintenance infusion is warranted, the rate is 1 to 4 mg/min.

**Adult ET tube:** 2 to 10 mg/kg ET tube, diluted in 10 mL normal saline or sterile distilled water

**Pediatric IV/IO:** 1 mg/kg IV, IO (maximum 100 mg); if a maintenance infusion is warranted, the rate is 20 to 50 mcg/kg/min.

**Pediatric ET tube:** 2 to 3 mg/kg ET tube, followed by a 5-mL flush of normal saline

**Perfusing Ventricular Rhythms:**

**Adult:**

- 0.5 to 0.75 mg/kg IV, IO (up to 1.0-1.5 mg/kg may be used). Repeat 0.5 to 0.75 mg/kg every 5 to 10 minutes to a maximum total dose of 3 mg/kg.
- A maintenance infusion of 1 to 4 mg/min (30-50 mcg/kg/min) is acceptable.

**Pediatric:**

- 1 mg/kg IV, IO; may repeat every 5 to 10 minutes to a maximum dose of 3 mg/kg
- Maintenance infusion rate is 20 to 50 mcg/kg/min.

# *Aspirin (ASA)*

**ASPIRIN, ASA** 10

**Classification:**
Analgesic, Antipyretic, Platelet Inhibitor


**INDICATIONS:**
- Fever
- Inflammation
- Angina
- Acute MI
- Patients complaining of pain, pressure, squeezing, or crushing in the chest that may be cardiac in origin

**MECHANISM OF ACTION:**
This prevents the formation of a chemical known as thromboxane $A_2$, which causes platelets to clump together, or aggregate, and form plugs that cause obstruction or constriction of small coronary arteries.

**ADVERSE REACTIONS:**
- Anaphylaxis
- Angioedema
- Bronchospasm
- Bleeding
- Stomach irritation
- Nausea/vomiting

Mosby's Paramedicine Drug Study Cards

# *Aspirin (ASA)*

## ASPIRIN, ASA

**CONTRAINDICATIONS:**

- GI bleeding
- Active ulcer disease
- Hemorrhagic stroke
- Bleeding disorders
- Children with chickenpox or flulike symptoms
- Known sensitivity

**DOSAGE:**

**Note:** "Baby aspirin" 81 mg, standard adult aspirin dose 325 mg

**Myocardial Infarction:**

**Adult:** 160 to 325 mg PO (alternatively, four 81-mg baby aspirin are often given), 300-mg rectal suppository

**Pediatric:** 3 to 5 mg/kg/day to 5 to 10 mg/kg/day given as a single dose

**Pain or Fever:**

**Adult:** 325 to 650 mg PO (1 to 2 adult tablets) every 4 to 6 hours

**Pediatric:** 60 to 90 mg/kg/day in divided doses every 4 to 6 hours

# *Fentanyl Citrate (Sublimaze)*



**Classification:**
Narcotic Analgesic


**MECHANISM OF ACTION:**
Binds to opiate receptors, producing analgesia and euphoria.

**INDICATIONS:**
- Pain

**ADVERSE REACTIONS:**
- Respiratory depression
- Apnea
- Hypotension
- Nausea/vomiting
- Dizziness
- Sedation
- Euphoria
- Sinus bradycardia
- Sinus tachycardia
- Palpitations
- Hypertension
- Diaphoresis
- Syncope
- Pain at injection site

# *Fentanyl Citrate (Sublimaze)*

## FENTANYL CITRATE (SUBLIMAZE)

**CONTRAINDICATIONS:**

- Known sensitivity
- Use with caution in traumatic brain injury
- Respiratory depression

**DOSAGE:**

Should be individualized

**Adult:** 50 to 100 mcg/dose (0.05 to 0.1 mg) IM or slow IV, IO (administered over 1 to 2 minutes)

**Pediatric:** 1 to 2 mcg/ kg IM or slow IV, IO (administered over 1 to 2 minutes)

# *Morphine Sulfate*

## MORPHINE SULFATE 62

**Classification:**

Narcotic Analgesic

### INDICATIONS:

- Moderate to severe pain, including chest pain associated with ACS, CHF, pulmonary edema

### MECHANISM OF ACTION:

Binds with opioid receptors. Morphine is capable of inducing hypotension by depression of the vasomctor centers of the brain, as well as release of the chemical histamine. In the management of angira, morphine reduces stimulation of the sympathetic nervous system caused by pain and anxiety. Reduction of sympathetic stimulation reduces heart rate, cardiac work, and myocardial oxygen consumption.

### ADVERSE REACTIONS:

- Respiratory depression
- Hypotension
- Nausea/vomiting
- Dizziness
- Lightheadedness
- Sedation
- Diaphoresis
- Euphoria
- Dysphoria
- Worsening of bradycardia and heart block in some patients with acute inferior wall MI, seizures, cardiac arrest, anaphylactoid reactions

# *Morphine Sulfate*

## MORPHINE SULFATE

**CONTRAINDICATIONS:**

- Respiratory depression
- Shock
- Known sensitivity
- Use with caution in hypotension, acute bronchial asthma, respiratory insufficiency, head trauma

**DOSAGE:**

Pain:

Adult:

- 2.5 to 15 mg IV, IO, IM, or Sub-Q administered slowly over a period of several minutes
- The dose is the same whether administered IV, IO, IM, or Sub-Q.

Pediatric:

- **6 months to 12 years:** 0.05 to 0.2 mg/kg IV, IO, IM, or Sub-Q
- **Younger than 6 months:** 0.03 to 0.05 mg/kg IV, IO, IM, or Sub-Q

**Chest Pain Associated with Acute Coronary Syndromes, Congestive Heart Failure, and Pulmonary Edema:**

Administer small doses and reevaluate the patient. Large doses may lead to respiratory depression and worsen the patient's hypoxia.

**Adult:** 2 to 4 mg slow IV, IO over a 1- to 5-minute period with increments of 2 to 8 mg repeated every 5 to 15 minutes until patient is relieved of chest pain

**Pediatric:** 0.1 to 0.2 mg/kg/dose IV, IO

# *Naloxone (Narcan)*

## NALOXONE (NARCAN) 64

**Classification:**

Narcotic Antngonist


**INDICATIONS:**

- Narcotic overdoses
- Reversal of narcotics used for procedure-related anesthesia

**ADVERSE REACTIONS:**

- Nausea/vomiting
- Restlessness
- Diaphoresis
- Tachycardia
- Hypertension
- Tremulousness
- Seizures
- Cardiac arrest
- Narcotic withdrawal
- Patients who have gone from a state of somnolence from a narcotic overdose to wide awake may become combative.

**MECHANISM OF ACTION:**

Binds to the opioid receptor and blocks the effect of narcotics.

# *Naloxone (Narcan)*

## NALOXONE (NARCAN)

**CONTRAINDICATIONS:**

- Known sensitivity to naloxone, nalmefene, or naltrexone
- Use with caution in patients with supraventricular arrhythmias or other cardiac disease, head trauma, or brain tumor

**DOSAGE:**

Adult:

- 0.4 to 2 mg IV, IO, ET tube, IM, or Sub-Q
- Alternatively, administer 2 mg intranasally. Higher doses (10-20 mg) may be required for overdoses of synthetic narcotics.
- A repeat dose of one-third to two-thirds the original dose is often necessary.

Pediatric:

- **5 years or older or weight >20 kg:** 2 mg IV, IO, ET, IM, or Sub-Q
- **Younger than 5 years or weight <20 kg:** 0.1 mg/kg IV, IO, ET, IM, or Sub-Q; may repeat every 2 to 3 minutes.

# *Diazepam (Valium)*

## DIAZEPAM (VALIUM) 20

**Classification:**

Benzodiazepine; Sedative-hypnotic, Anticonvulsant, Antianxiety

**MECHANISM OF ACTION:**

Binds to the benzodiazepine receptor and enhances the effects of GABA. Benzodiazepines act at the level of the limbic, thalamic, and hypothalamic regions of the CNS and can produce any level of CNS depression required (including sedation, skeletal muscle relaxation, and anticonvulsant activity).

**INDICATIONS:**

- Anxiety
- Skeletal muscle relaxation
- Alcohol withdrawal
- Seizures

**ADVERSE REACTIONS:**

- Respiratory depression
- Drowsiness
- Fatigue
- Headache
- Pain at the injection site
- Confusion
- Nausea
- Hypotension
- Oversedation

**CONTRAINDICATIONS:**

- Children younger than 6 months
- Acute-angle glaucoma
- CNS depression
- Alcohol intoxication
- Known sensitivity

Mosby's Paramedicine Drug Study Cards

# *Diazepam (Valium)*

## DIAZEPAM (VALIUM)

**DOSAGE:**

Anxiety:

Adult:

- **Moderate:** 2 to 5 mg slow IV, IM
- **Severe:** 5 to 10 mg slow IV, IM (administered no faster than 5 mg/min)
- **Low:** Low dosages are often required for elderly or debilitated patients.

**Pediatric:** 0.04 to 0.3 mg/kg/dose IV, IM every 4 hours to a maximum dose of 0.6 mg/kg.

Delirium Tremens from Acute Alcohol Withdrawal:

**Adult:** 10 mg IV

Seizure:

**Adult:** 5 to 10 mg slow IV, IO every 10 to 15 minutes; maximum total dose 30 mg

Pediatric:

- IV, IO:
  - **5 years and older:** 1 mg over a 3-minute period every 2 to 5 minutes to a maximum total dose of 10 mg
  - **Older than 30 days to younger than 5 years:** 0.2 to 0.5 mg over a 3-minute period; may repeat every 2 to 5 minutes to a maximum total dose of 5 mg

**Neonate:** 0.1 to 0.3 mg/kg/dose given over a 3- to 5-minute period; may repeat every 15 to 30 minutes to a maximum total dose of 2 mg (not a first-line agent due to sodium benzoic acid in the injection)

- **Rectal administration:** If vascular access is not obtained, diazepam may be administered rectally to children.
  - **12 years and older:** 0.2 mg/kg
  - **6 to 11 years:** 0.3 mg/kg
  - **2 to 5 years:** 0.5 mg/kg
  - **Younger than 2 years:** Not recommended

# *Midazolam (Versed)*

## MIDAZOLAM (VERSED) 60

**Classification:**

Benzodiazepine; Sedative


**INDICATIONS:**

- Sedation
- Anxiety
- Skeletal muscle relaxation

**ADVERSE REACTIONS:**

- Respiratory depression/arrest
- Hypotension
- Nausea/vomiting
- Headache
- Hiccups
- Cardiac arrest

**MECHANISM OF ACTION:**

Binds to the benzodiazepine receptor and enhances the effects of GABA. Produces short-acting CNS depression (including sedation, skeletal muscle relaxation, and anticonvulsant activity).

**CONTRAINDICATIONS:**

- Acute-angle glaucoma
- Pregnant women
- Known sensitivity

# *Midazolam (Versed)*

## MIDAZOLAM (VERSED)

**DOSAGE:**

Note: The dose of midazolam must be individualized.

Adult:

- **Healthy and <60 years:** *Some patients require as little as 1 to 2.5 mg IV, IO over 2 mins. May repeat in 2 min (max: 5 mg).* If the patient also has received a narcotic, he or she will typically require 30% less midazolam.
- **>60 years and debilitated or chronically ill patients:** *1 to 1.5 mg IV, IO, and no more than 1.5 mg over 2 minutes.* May repeat at a rate of no more than 1 mg over 2 minutes (max: 3.5 mg). If the patient also has received a narcotic, he or she will typically require 50% less midazolam.
- **Adult-continuous infusion:** Continuous infusions can be required for prolonged transport of intubated, critically ill, and injured patients. 0.02 to 0.1 mg/kg/hr (1-7 mg/hr).

Pediatric:

- **Weight-based:** Pediatric patients typically require higher doses than do adults on the basis of weight (in mg/kg). Younger pediatric patients (younger than 6 years) require higher doses (in mg/kg) than older pediatric patients.
- **12 to 16 years:** Same as adult dosing (max: 10 mg).
- **6 to 12 years:** 0.025 to 0.05 mg/kg IV, IO up to a total dose of 0.4 mg/kg. Exceeding 10 mg as total dose usually is not necessary.
- **6 months to 5 years:** 0.05 to 0.1 mg/kg IV, IO up to a total dose of 0.6 mg/kg. Exceeding 6 mg as total dose usually is not necessary.
- **Younger than 6 months:** Dosing recommendation for this age group is unclear. **Dose:** 0.05 to 0.1 mg/kg IV, IO

# *Flumazenil (Romazicon)*

## FLUMAZENIL (ROMAZICON) 35

**Classification:**
Benzodiazepine Antagonist


**MECHANISM OF ACTION:**
Competes with benzodiazepines for binding at the benzodiazepine receptor, reverses the sedative effects of benzodiazepines.

**INDICATIONS:**
- Benzodiazepine oversedation

**ADVERSE REACTIONS:**
- Resedation
- Seizures
- Dizziness
- Pain at injection site
- Nausea/vomiting
- Diaphoresis
- Headache
- Visual impairment

# *Flumazenil (Romazicon)*

## FLUMAZENIL (ROMAZICON)

**CONTRAINDICATIONS:**

- Cyclic antidepressant overdose
- Life-threatening conditions that require treatment with benzodiazepines, such as status epilepticus and intracranial hypertension
- Known sensitivity to flumazenil or benzodiazepines
- Use with caution where there is the possibility of unrecognized benzodiazepine dependence and in patients who have a history of substance abuse or who are known substance abusers

**DOSAGE:**

Adult:

- 0.2 mg IV, IO administered over a 15-second period
- If the desired effect is not observed after 45 seconds, administer a second 0.2-mg dose, again over a 15-second period.
- Doses can be repeated a total of four times until a total dose of 1 mg has been administered.

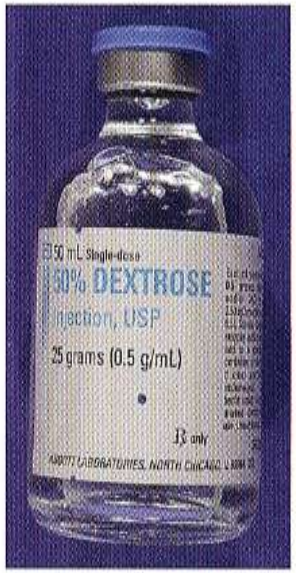
Pediatric

- **For children older than 1 year:** the dose is 0.01 mg/kg IV, IO given over a 15-second period.
- May repeat in 45 seconds and then every minute to a maximum cumulative dose of 0.05 mg/kg or 1 mg, whichever is the lower dose

# *Dextrose (50%, 25%, 10%)*

## DEXTROSE (DEXTROSE 50%, DEXTROSE 25%, DEXTROSE 10%) 19

**Classification:**
Carbohydrate




**MECHANISM OF ACTION:**
Increases blood glucose concentrations.

**INDICATIONS:**
- Hypoglycemia

**ADVERSE REACTIONS:**
- Hyperglycemia
- Warmth, burning from IV infusion
- Concentrated solutions may cause pain and thrombosis of the peripheral veins.

**CONTRAINDICATIONS:**
- Intracranial and intraspinal hemorrhage
- Delirium tremens
- Solution is not clear
- Seals are not intact

# *Dextrose (50%, 25%, 10%)*

## DEXTROSE (DEXTROSE 50%, DEXTROSE 25%, DEXTROSE 10%)

**DOSAGE:**

Hyperkalemia:

**Adult:** 25 g dextrose 50% IV, IO

**Pediatric:** 0.5 to 1 g/kg IV, IO

Hypoglycemia:

**Adult:** 10 to 25 g of dextrose 50% IV (20 to 50 mL of dextrose solution)

Pediatric

- **Older than 2 years:** 2 mL/kg of dextrose 50%
- **Younger than 2 years:** 2 to 4 mL/kg of dextrose 10%

# *Magnesium Sulfate*

## MAGNESIUM SULFATE 55

**Classification:**
Electrolyte


### INDICATIONS:
- Torsades de pointes
- Cardiac arrhythmias associated with hypomagnesemia
- Eclampsia and seizure prophylaxis in preeclampsia
- Status asthmaticus

### ADVERSE REACTIONS:
- Magnesium toxicity (signs include flushing, diaphoresis, hypotension, muscle paralysis, weakness, hypothermia, and cardiac, CNS, or respiratory depression)

### MECHANISM OF ACTION:
This is required for normal physiologic functioning. Magnesium is a cofactor in neurochemical transmission and muscular excitability. Magnesium sulfate controls seizures by blocking peripheral neuromuscular transmission. Magnesium is also a peripheral vasodilator and an inhibitor of platelet function.

### CONTRAINDICATIONS:
- AV heart block
- GI obstruction
- Use with caution in renal impairment

# *Magnesium Sulfate*

## MAGNESIUM SULFATE

**DOSAGE:**

Pulseless Ventricular Fibrillation/Ventricular Tachycardia with Torsades De Pointes or Hypomagnesemia:

**Adult:** 1 to 2 g in 10 mL $D_5W$ IV, IO administered over 5 to 10 minutes

**Pediatric:** 25 to 50 mg/kg IV, IO over 10 to 20 minutes; may administer faster for torsades de pointes (max single dose: 2 g)

Torsades De Pointes with a Pulse or Cardiac Arrhythmias with Hypomagnesemia:

**Adult:**

- 1 to 2 g in 50 to 100 mL $D_5W$ IV, IO administered over 5 to 60 minutes
- Follow with 0.5 to 1 g/hr IV, IO titrated to control torsades de pointes

**Pediatric:** 25 to 50 mg/kg IV, IO over 10 to 20 minutes (max single dose: 2 g)

Eclampsia and Seizure Prophylaxis in Preeclampsia:

**Adult:** 4 to 6 g IV, IO over 20 to 30 minutes, followed by an infusion of 1 to 2 g/hr

Status Asthmaticus:

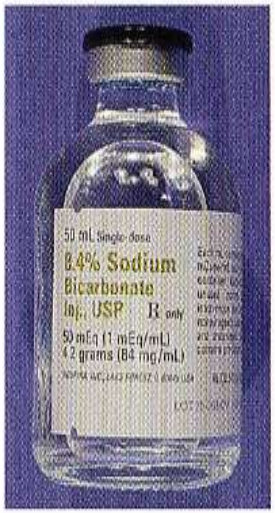
**Adult:** 1.2 to 2.0 g slow IV, IO (over 20 minutes)

**Pediatric:** 25 to 50 mg/kg (diluted in $D_5W$) slow IV, IO (over 10 to 20 minutes)

# *Sodium Bicarbonate*



**Classification:**
Electrolyte




**MECHANISM OF ACTION:**
Counteracts existing acidosis.

**INDICATIONS:**
- Acidosis
- Drug intoxications (e.g., barbiturates, salicylates, methyl alcohol)

# *Sodium Bicarbonate*

## SODIUM BICARBONATE

**ADVERSE REACTIONS:**

- Metabolic alkalosis
- Hypernatremia
- Injection site reaction
- Sodium and fluid retention
- Peripheral edema

**CONTRAINDICATIONS:**

- Metabolic alkalosis

**DOSAGE:**

Metabolic Acidosis during Cardiac Arrest:
1 mEq/kg slow IV, IO; may repeat at
0.5 mEq/kg in 10 minutes
Metabolic Acidosis Not Associated with Cardiac Arrest: Dosage should be individualized.

# *Glucagon*



**Classification:**
Hormone


**MECHANISM OF ACTION:**
Converts glycogen to glucose.

**INDICATIONS:**
- Hypoglycemia
- Beta blocker overdose

**ADVERSE REACTIONS:**
- Nausea/vomiting
- Rebound hyperglycemia
- Hypotension
- Sinus tachycardia

# *Glucagon*

## GLUCAGON

**CONTRAINDICATIONS:**

- Pheochromocytoma
- Insulinoma
- Known sensitivity

**DOSAGE:**

Hypoglycemia:

**Adult:** 1 mg IM, IV, IO, Sub-Q

**Pediatric:** (<20 kg) 0.5 mg IM, IV, IO, Sub-Q

Beta blocker overdose:

**Adult:** 2 to 5 mg IV, IO over a 1-minute period, followed by a second dose of 10 mg IV if the symptoms of bradycardia and hypotension recur (Note that this dose is much higher than the dose required to treat hypoglycemia.)

**Pediatric: For patients weighing <20 kg:** 0.5 mg

# *Vasopressin*

## VASOPRESSIN 92

**Classification:**
Hormone; Vasopressor


**MECHANISM OF ACTION:**
Vasopressin causes vasoconstriction independent of adrenergic receptors or neural innervation.

**INDICATIONS:**
- Adult shock-refractory VF or pulseless VT
- Asystole
- PEA
- Vasodilatory shock

# *Vasopressin*

## VASOPRESSIN

**ADVERSE REACTIONS:**

- Cardiac ischemia
- Angina

**CONTRAINDICATIONS:**

- Responsive patients with cardiac disease

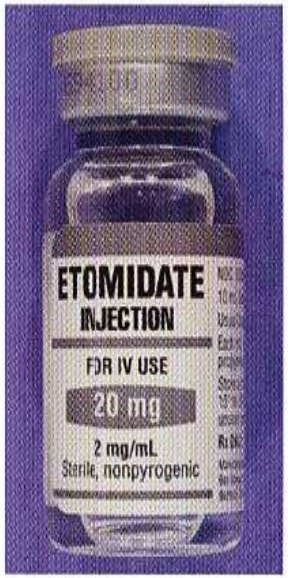
**DOSAGE:**

- 40 U IV/IO may replace either the first or second dose of epinephrine.
- May be given ET, but the optimal dose is not known

# *Etomidate (Amidate)*

## ETOMIDATE (AMIDATE) 31

**Classification:**
Hypnotic




**MECHANISM OF ACTION:**
Although the exact mechanism is unknown, etomicate appears to have GABA-like effects.

**INDICATIONS:**
- Induction for rapid sequence intubation and pharmacologic-assisted intubation
- Induction of anesthesia

**ADVERSE REACTIONS:**
- Hypotension
- Respiratory depression
- Pain at the site of injection
- Temporary involuntary muscle movements
- Frequent nausea/vomiting on emergence
- Adrenal insufficiency
- Hyperventilation
- Hypoventilation
- Apnea of short duration
- Hiccups

# *Etomidate (Amidate)*

## ETOMIDATE (AMIDATE)

***(ADVERSE REACTIONS—CONT'D)***

- Laryngospasm
- Snoring
- Tachypnea
- Hypertension
- Cardiac arrhythmias

**CONTRAINDICATIONS:**

- Known sensitivity
- Use in pregnancy only if the potential benefits justify the potential risk to the fetus
- Do not use during labor and avoid in nursing mothers

**DOSAGE:**

Adult:

- 0.2 to 0.6 slow mg/kg IV, IO (over 30 to 60 seconds). A typical adult intubating dose of etomidate is 20 mg slow IV.
- Consider less (e.g., 10 mg) in the elderly or patients with cardiac conditions

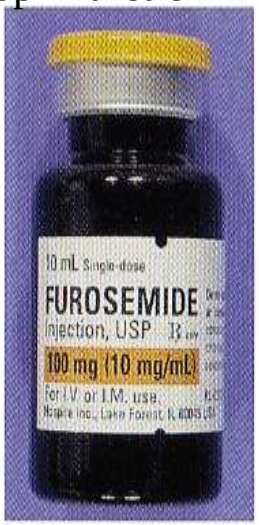
Pediatric:

- **Older than 10 years:** Same as adult dosing
- **Younger than 10 years:** Safety has not been established.

# *Furosemide (Lasix)*

## FUROSEMIDE (LASIX) 37

**Classification:**
Loop Diuretic




**INDICATIONS:**
- Pulmonary edema
- CHF
- Hypertensive emergency

**ADVERSE REACTIONS:**
- Vertigo
- Dizziness
- Weakness
- Orthostatic hypotension
- Hypokalemia
- Thrombophlebitis
- Patients with anuria, severe renal failure, untreated hepatic coma, increasing azotemia, and electrolyte depletion can develop life-threatening consequences.

**MECHANISM OF ACTION:**
Inhibits the absorption of the sodium and chloride ions and water in the loop of Henle, as well as the convoluted tubule of the nephron. This results in decreased absorption of water and increased production of urine.

# *Furosemide (Lasix)*

## FUROSEMIDE (LASIX)

**CONTRAINDICATIONS:**

- Known sensitivity to sulfonamides or furosemide

**DOSAGE:**

Congestive Heart Failure and Pulmonary Edema:

Adult:

1mg/kg IV, IO administered slowly over a 1- to 2-minute period

- If a satisfactory response is not achieved within 1 hour, an additional dose of 80 mg can be given.
- A maximum single IV dose is 160 to 200 mg.

Pediatric:

- 1 mg/kg IV, IO or IM
- If the response is not satisfactory, an additional dose of 2 mg/kg may be administered no sooner than 2 hours after the first dose.

Hypertensive Emergency:

**Adult:** 40 to 80 mg IV/IO

**Pediatric:** 1 mg/kg IV or IM

# *Nitroglycerin (Nitrostat)*

## NITROGLYCERIN (NITROSTAT, NITRO-BID, NITROLINGUAL, NITRO-DUR, NITROQUICK)



**Classification:**
Nitrate


**MECHANISM OF ACTION:**
Relaxes vascular smooth muscle, thereby dilating peripheral arteries and veins.

**INDICATIONS:**
- Angina
- Hypertension
- Myocardial ischemia associated with cocaine intoxication

**ADVERSE REACTIONS:**
- Headache
- Hypotension
- Bradycardia
- Lightheadedness
- Flushing
- Cardiovascular collapse

# *Nitroglycerin (Nitrostat)*

## NITROGLYCERIN (NITROSTAT, NITRO-BID, NITROLINGUAL, NITRO-DUR, NITROQUICK)

**CONTRAINDICATIONS:**

- Hypotension
- Severe bradycardia or tachycardia
- Increased ICP
- Patients taking any medications for erectile dysfunction (such as sildenafil [Viagra], tadalafil [Cialis], or vardenafil [Levitra])
- Known sensitivity to nitrates

**DOSAGE:**

Adult:

- **Sublingual tablets:** 1 tablet (0.3-0.4 mg) at 5-minute intervals to a maximum of 3 doses
- **Translingual spray:** 1 (0.4 mg) spray at 5-minute intervals to a maximum of 3 sprays
- **Ointment:** 2% topical (Nitro-Bid ointment): Apply 1 to 2 inches of paste over the chest wall, cover with transparent wrap, and secure with tape.

**IV:**

- **Bolus:** 12.5 to 25 mcg
- **Infusion:** 5 mcg/min: increase rate by 5 to 10 mcg/min every 5 to 10 minutes as needed. End points of dose titration for nitroglycerin include a drop in the blood pressure of 10%, relief of chest pain, and return of ST-segment to normal on a 12-lead ECG.

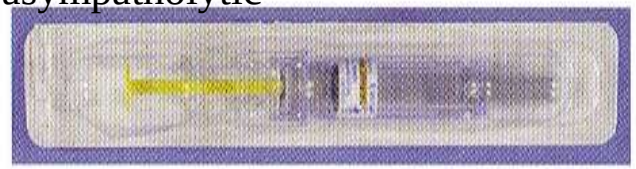
Pediatric

- **Pediatric IV infusion:** The initial pediatric infusion is 0.25 to 0.5 mcg/kg/min IV, IO titrated by 0.5 to 1 mcg/kg/min. Usual required dose is 1 to 3 mcg/kg/min to a maximum dose of 5 mcg/kg/min.

# *Atropine Sulfate*

## ATROPINE SULFATE 13

**Classification:**
Parasympatholytic



### MECHANISM OF ACTION:
Competes reversibly with acetylcholine at the site of the muscarinic receptor.

### INDICATIONS:
- Symptomatic bradycardia, asystole or PEA
- Nerve agent exposure
- Organophosphate poisoning

### ADVERSE REACTIONS:
- Dry mouth, hot skin temperature, intense facial flushing
- Blurred vision or dilation of the pupils with subsequent photophobia
- Tachycardia
- Restlessness
- Atropine may cause paradoxical bradycardia if the dose administered is too low, or if the drug is administered too slowly.

### CONTRAINDICATIONS:
- Acute MI
- Myasthenia gravis
- GI obstruction
- Closed-angle glaucoma
- Known sensitivity to atropine, belladonna alkaloids, or sulfites

# *Atropine Sulfate*

## ATROPINE SULFATE

**DOSAGE:**

Symptomatic Bradycardia:

**Adult:** 0.5 mg IV, IO every 3 to 5 minutes to a maximum dose of 3 mg.

**Adolescent:** 0.02 mg/kg (minimum 0.1 mg/dose; maximum 1 mg/dose) IV, IO up to a total dose of 2 mg

**Pediatric:** 0.02 mg/kg (minimum 0.1 mg/dose; maximum 0.5 mg/dose) IV, IO, to a total dose of 1 mg.

Asystole/Pulseless Electrical Activity:

- 1 mg IV, IO every 3 to 5 minutes, to a maximum dose of 3 mg.
- May be administered via ET tube at 2 to 2.5 mg diluted in 5 to 10 mL of water or normal saline.

Nerve Agent or Organophosphate Poisoning:

Adult:

- 2 to 4 mg IV, IM; repeated if needed every 20 to 30 minutes until symptoms dissipate
- In severe cases, the initial dose can be as large as 2 to 6 mg administered IV.
- Repeat doses of 2 to 6 mg can be administered IV, IM every 5 to 60 minutes.

**Pediatric:** 0.05 mg/kg IV, IM every 10 to 30 minutes as needed until symptoms dissipate

**Infants <15 lb:** 0.05 mg/kg IV, IM every 5 to 20 minutes as needed until symptoms dissipate.

# *Dopamine (Intropin)*

## DOPAMINE (INTROPIN) 26

**Classification:**
Sympathomimetic


### MECHANISM OF ACTION:

Stimulates alpha and beta adrenergic receptors. At moderate doses (2-10 mcg/kg/min), dopamine stimulates $beta_1$ receptors, resulting in inotropy and increased cardiac output while maintaining dopaminergic-induced vasodilatory effects. At high doses (>10 mcg/kg/min), alpha adrenergic agonism predominates, and increased peripheral vascular resistance and vasoconstriction result.

### INDICATIONS:

- Hypotension and decreased cardiac output associated with cardiogenic shock and septic shock
- Hypotension after return of spontaneous circulation following cardiac arrest
- Symptomatic bradycardia unresponsive to atropine

# *Dopamine (Intropin)*

## DOPAMINE (INTROPIN)

**ADVERSE REACTIONS:**

- Tachycardia
- Arrhythmias
- Skin and soft tissue necrosis
- Severe hypertension from excessive vasoconstriction
- Angina
- Dyspnea
- Headache
- Nausea/vomiting

**CONTRAINDICATIONS:**

- Pheochromocytoma
- VF, VT, other ventricular arrhythmias
- Known sensitivity (including sulfites)
- Correct any hypovolemia with volume fluid replacement before administering dopamine

**DOSAGE:**

- 2 to 20 mcg/kg/min IV, IO infusion
- Starting dose 5 mcg/kg/min; may gradually increase the infusion by 5 to 10 mcg/kg/min to desired effect
- Cardiac dose is usually 5 to 10 mcg/kg/min; vasopressor dose is usually 10 to 20 mcg/kg/min
- Little benefit is gained beyond 20 mcg/kg/min

# *Epinephrine (Adrenaline)*

## EPINEPHRINE 27

**Classification:**
Sympathomimetic


**INDICATIONS:**
- Bronchospasm
- Allergic and anaphylactic reactions
- Cardiac arrest

**ADVERSE REACTIONS:**
- Anxiety, nervousness, tremors
- Chest pain, cardiac arrhythmias
- Hypertension
- Nausea/vomiting, headache

**CONTRAINDICATIONS:**
- Arrhythmias other than VF, asystole, PEA
- Cardiovascular disease
- Hypertension
- Cerebrovascular disease
- Shock secondary tc causes other than anaphylactic shock

**MECHANISM OF ACTION:**
Increased bp, hr, and bronchodilates by binding with both alpha and beta receptors.

# *Epinephrine (Adrenaline)*

## EPINEPHRINE

***(CONTRAINDICATIONS—CONT'D)***

- Closed-angle glaucoma
- Diabetes
- Pregnant women in active labor
- Known sensitivity to epinephrine or sulfites

**DOSAGE:**

Cardiac Arrest:

**Adult:** 1 mg (1:10,000 solution) IV, IO; may repeat every 3 to 5 minutes

**Pediatric:** 0.01 mg/kg (1:10,000 solution) IV, IO; repeat every 3 to 5 minutes as needed (max dose: 1 mg)

Symptomatic Bradycardia:

**Adult:** 1 mcg/min (1:10,000 solution) as a continuous IV infusion; usual dosage range: 2 to 10 mcg/min IV; titrate to effect

**Pediatric:** 0.01 mg/kg (1:10,000 solution) IV, IO; may repeat every 3 to 5 minutes (max dose: 1 mg); if giving epinephrine by ET tube, administer 0.1 mg/kg

Asthma Attacks and Certain Allergic Reactions:

**Adult:** 0.3 to 0.5 mg (1:1000 solution) IM or Sub-Q; may repeat every 10 to 15 minutes (max dose: 1 mg)

**Pediatric:** 0.01 mg/kg (1:1000 solution) IM or Sub-Q (max dose: 0.5 mg)

Anaphylactic Shock:

**Adult:** 0.1 mg (1:10,000 solution) IV slowly over 5 minutes, or IV infusion of 1 to 4 mcg/min, titrated to effect

**Pediatric:** Continuous IV infusion rate of 0.1 to 1 mcg/kg/min (1:10,000 solution); titrate to response

# *Summary*

- Names of Drugs
- Sources of drugs
- Drug Classification
- Sources of drug information
- “Classic” Pharmacologic Format
- Schedule of controlled substances
- Special considerations in drug therapy
- The scope of management
- Autonomic pharmacology
- General properties of drugs
- Drug forms
- Routes of medication administration
- Commonly used ACLS Drugs

# *Medication Dosage Calculations*

Questions?